

Malting Barley and the World

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Agenda

- Trip around the world in recognition of Seattle's flying history
- Review of Malting
- Malting as it relates to Brewing
- Barley around the world



Barley as it Relates to Malting

- Barley is the soul of Beer
- All kernels must grow: free of sprout or chitted kernels
- All kernels must grow evenly: S&B or Skinned
- Correct protein levels
- Free of mold, vermin etc.



Barley Malt

- The Roll of Malt in Brewing
- Malt Biochemistry
- The Malting Process

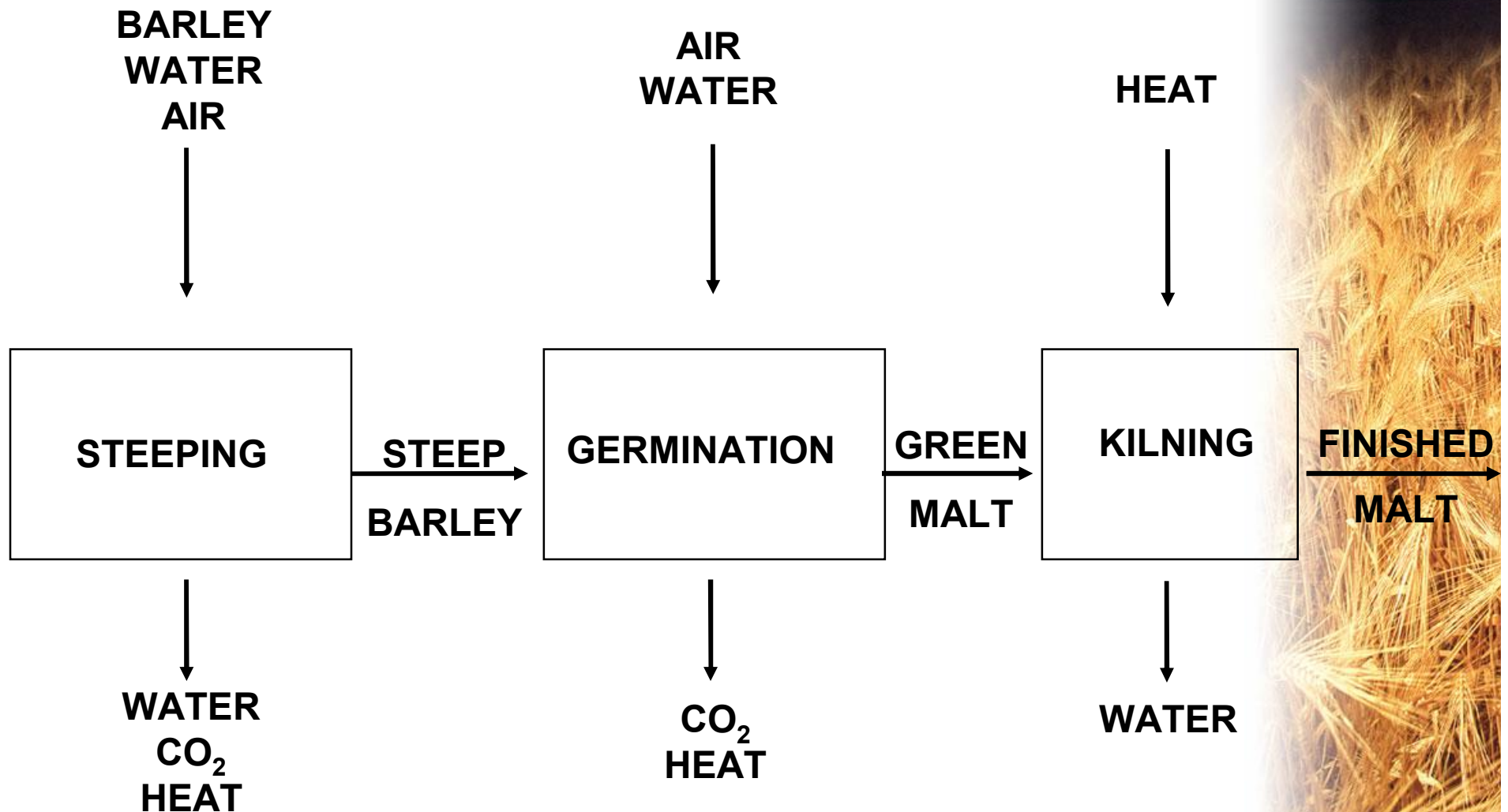


Barley Malt Contributions to Brewing

- Source of Carbohydrates
- Source of Protein
- Source of enzymes to reduce carbohydrates to fermentable sugar
- Source of enzymes to reduce proteins
- Source of filter material for “Wort” clarification
- Source of Color and Flavor



Malting Process

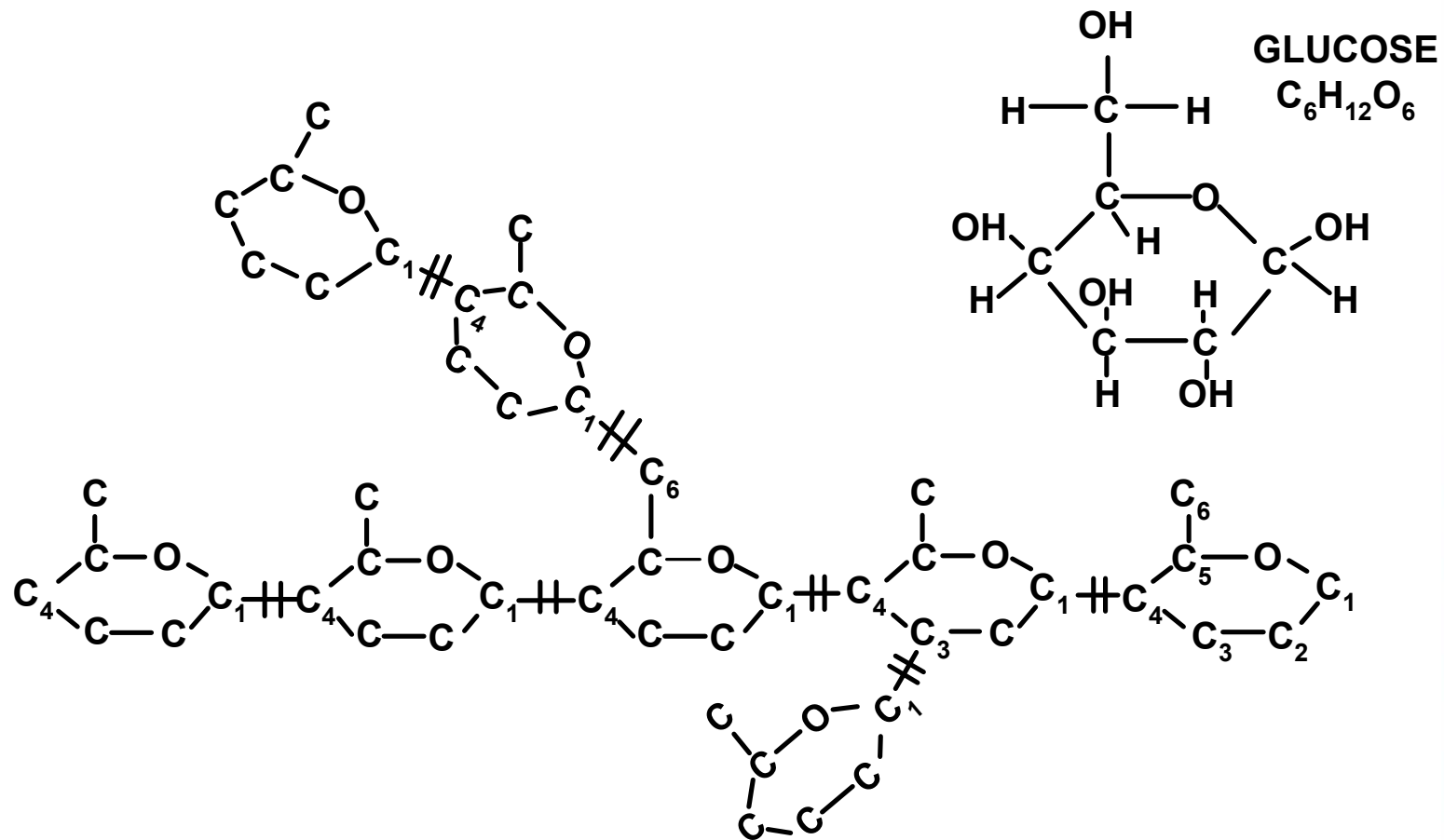


Carbohydrates

- Most abundant organic compound in nature
- All are built as chains from Glucose – $C_6H_{12}O_6$
- All are built by plant photosynthesis
- Common forms we recognize are sugar, starch and cellulose



Carbohydrates



Proteins

- Basic raw material in tissue and cell building
- All are built as chains from 20-25 different amino acids
- Amino acids are built from nitrogen, carbon, hydrogen, oxygen and sometimes sulfur
- All are built by plant photosynthesis



Enzymes

- The “Worker” proteins
- Catalysts that regulate the speed of chemical reactions without being involved in or consumed by the reaction
- Function by reducing carbohydrate and protein chains by breaking bonds between glucose units and amino acid units



Barley Benefits

- Source of filter material for “Wort” clarification
 - Other grains can be malted
 - Barley malt is the best package for **Brewing**
- Source of color and flavor
 - 100% of Beer Color comes from barley malt
 - Significant amount of beer flavor derived from barley malt



Clean Barley

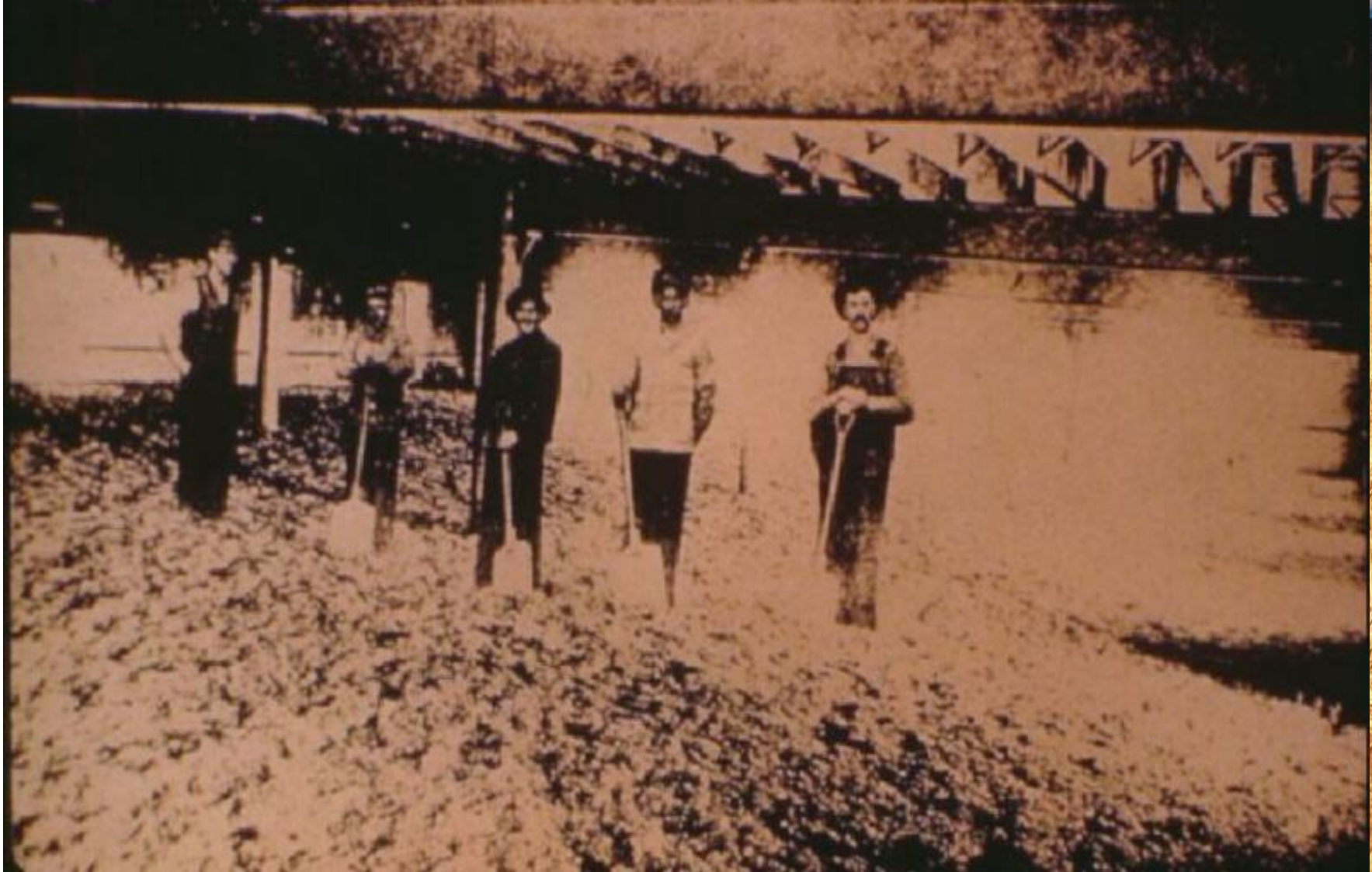


Malting Process

- Agricultural product in: Barley
- Food product out: Malt
 - All FDA processing/sanitary requirements in place
- Production cycle 8-10 days
- Malt is aged 21 days minimum before shipment
- Ship to brewery
 - Mostly railcars



Floor Malting



Steep Operation



Chitted Barley



Germination Filling



Germination Day One



Germination Vessel



Germination Vessel Filling



12 Billion Kernels



Kiln



Kiln Loaded

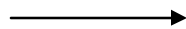


Maillard Reactions

Barley Components

Resulting Compounds from Malt Modification

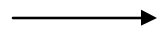
Starch
Cell Walls



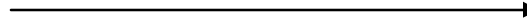
Simple
Sugars

+

Proteins



Amino
Acids




Add Heat

Color and
Flavor
Compounds

The rate of reaction is impacted by available water, temperature and pH.



Specialty Malt Flavor Profiles

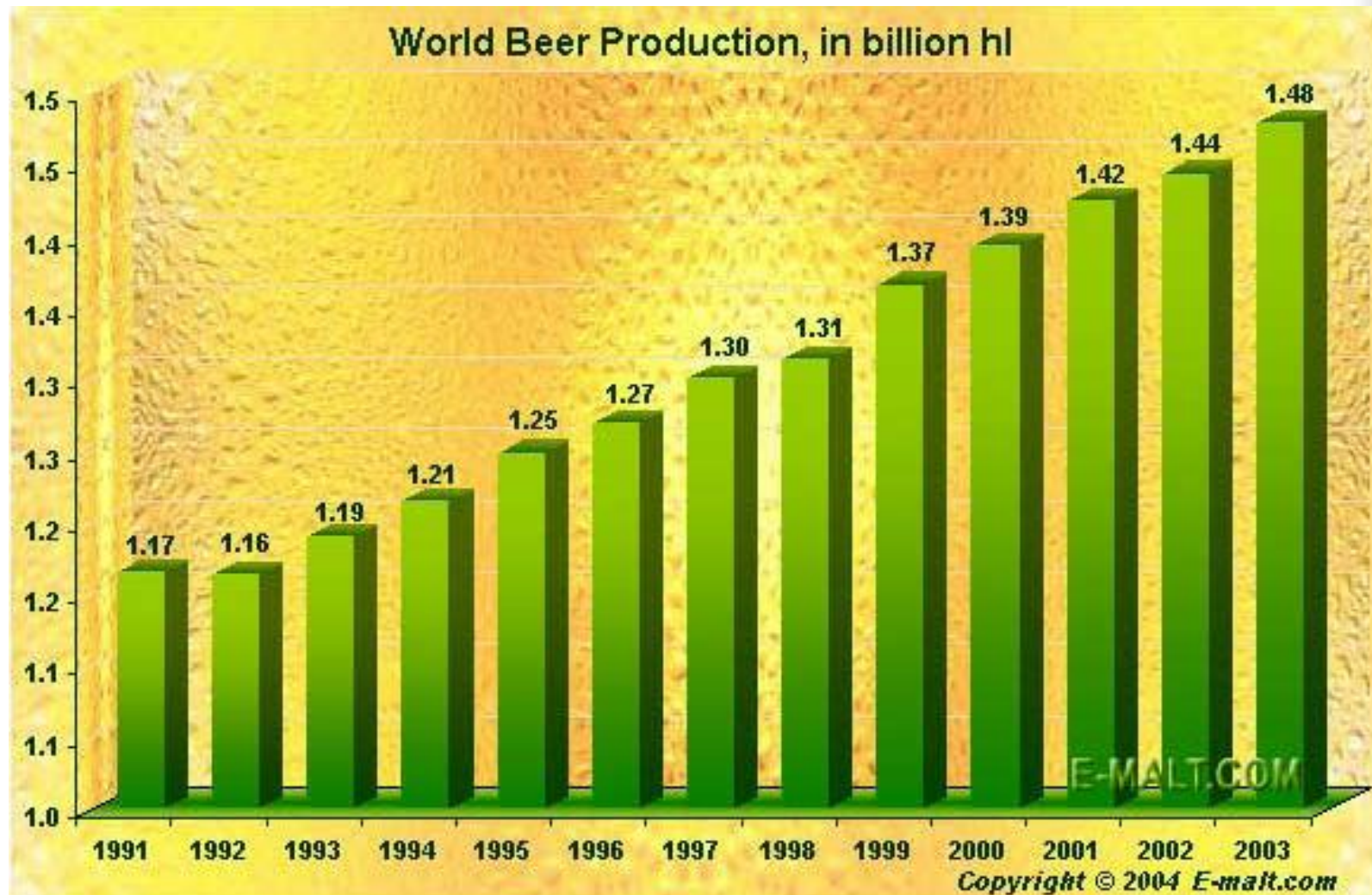
Specialty Malt			
Vienna Munich Hi-Dried	Caramel Crystal	Brown Chocolate	Black Roasted Barley
Flavor Attributes			
Sweet Malty	Caramel Very Slight Winey	Nutty Sl. Burnt Biscuit	Coffee Chocolate Sl. Dry/Harsh Phenolic Smoky Astringent Burnt Metallic Bitter
Color and Flavor Derived From...			
 <div> <div>Melanoidin formation, sugar degradation, or pyrolysis</div> <div>Oxidized polyphenols, amino acids</div> </div>			



Barley Malt Around the World



World Beer Growth



China Beer Growth



Chinese Brewery



Chinese Barley Infrastructure



World Malting Barley

World Malting Barley Exports 2004-2005f

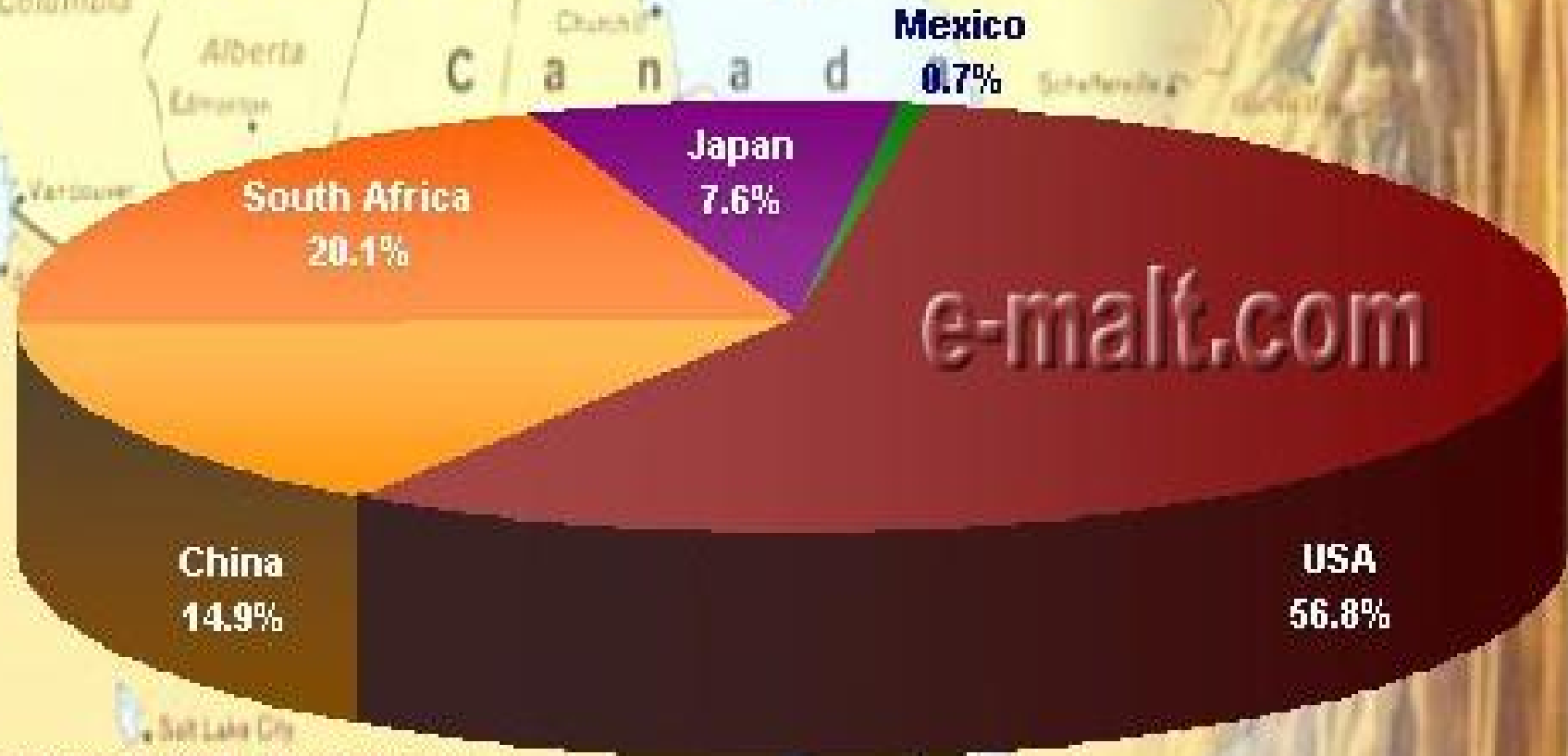
World Malting Barley Trade in 2004-2005f: 4.8 million tonnes *



Canada Exports

Canada malting barley exports by countries 2002-2003

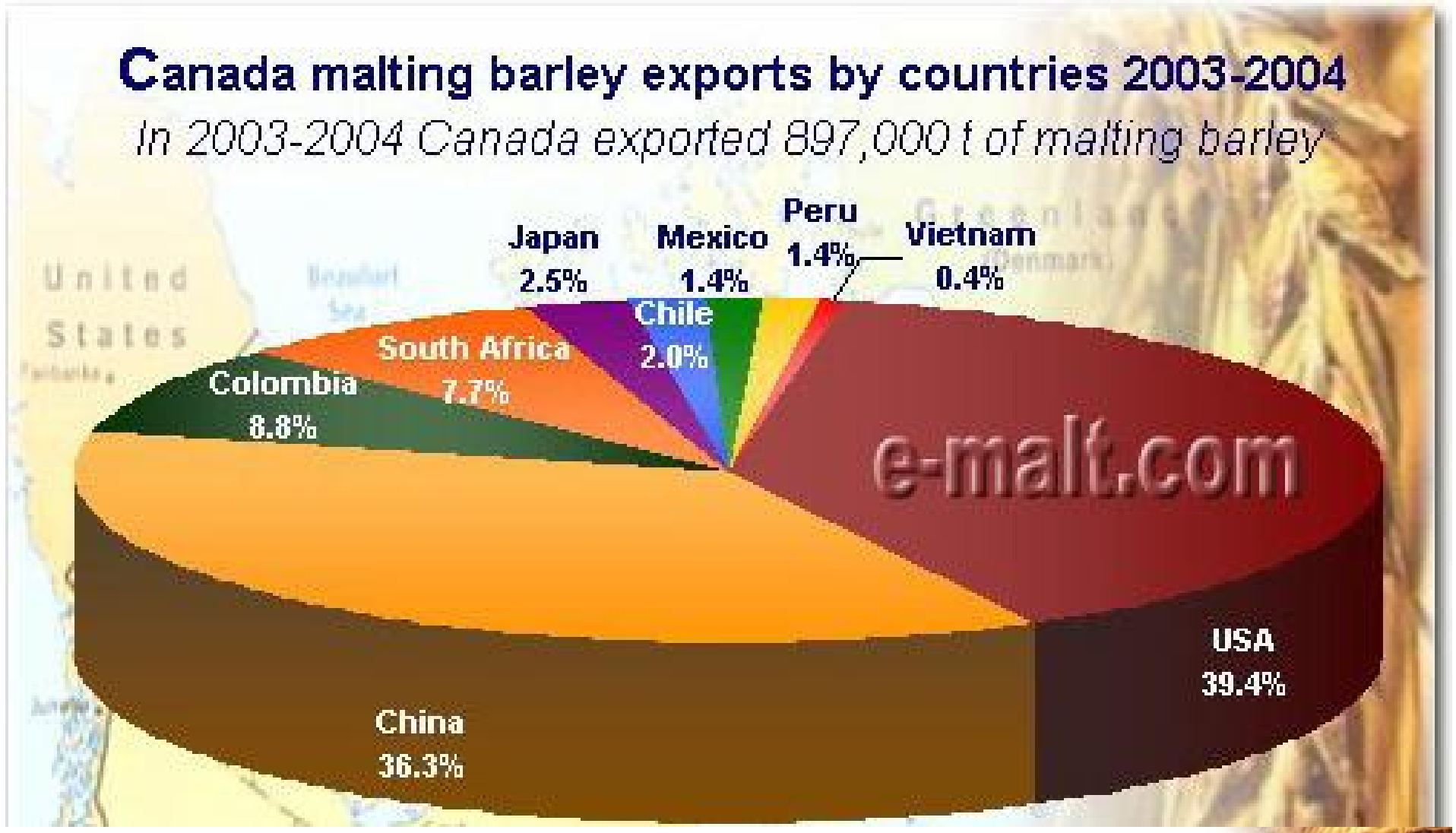
In 2002-2003 Canada exported 303,000 t of malting barley



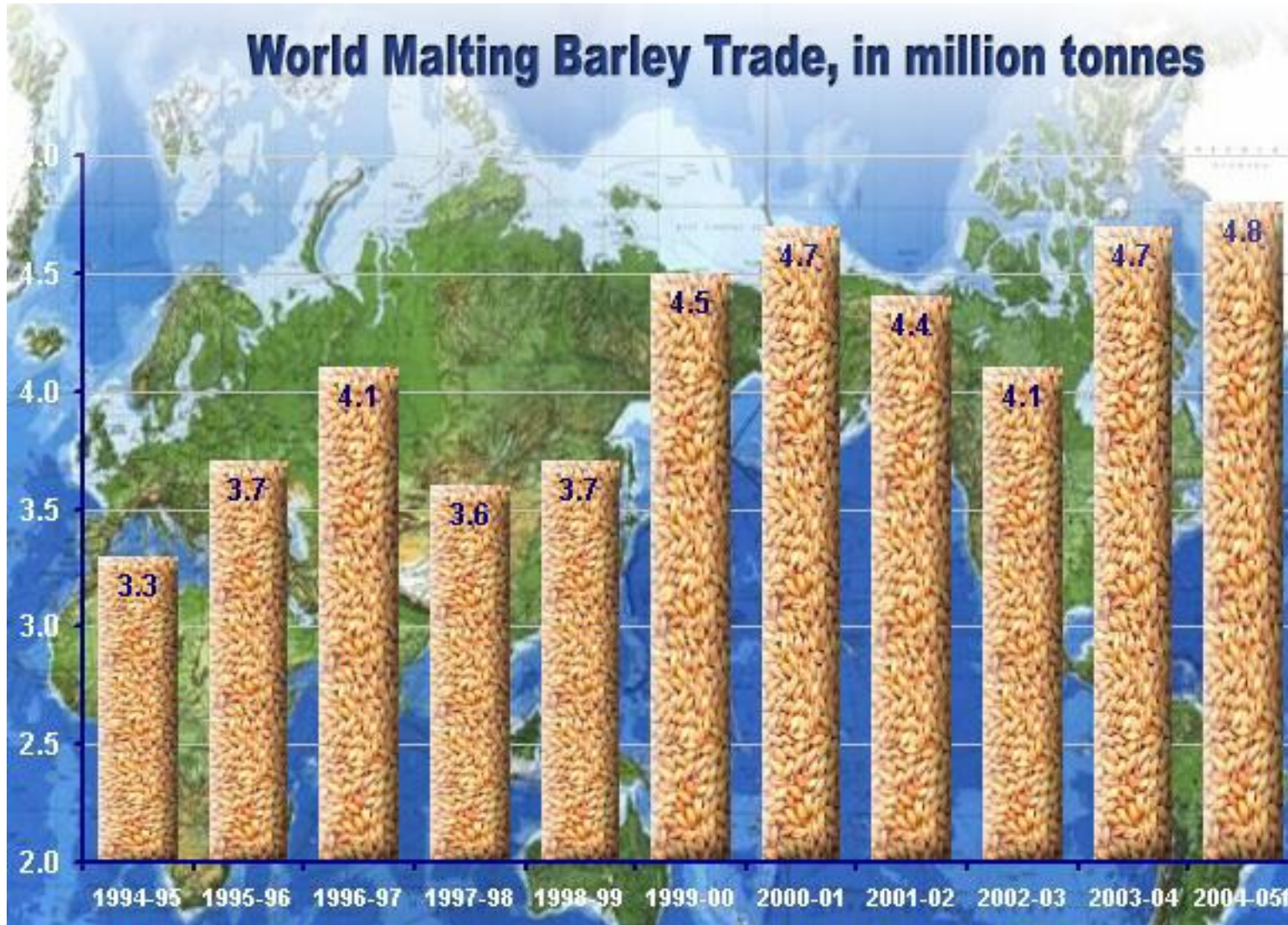
Canada Exports

Canada malting barley exports by countries 2003-2004

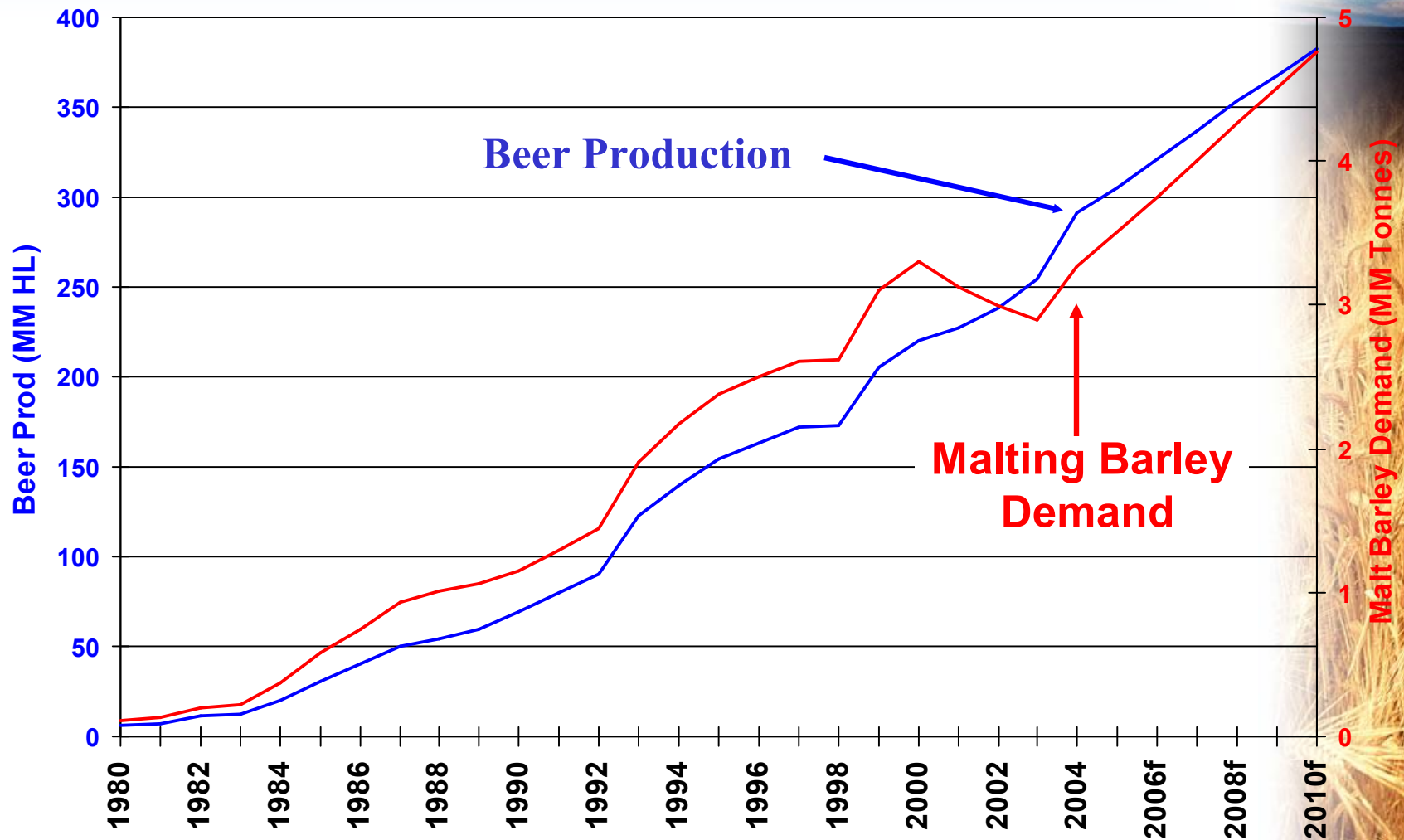
In 2003-2004 Canada exported 897,000 t of malting barley



World Malting Barley Growth

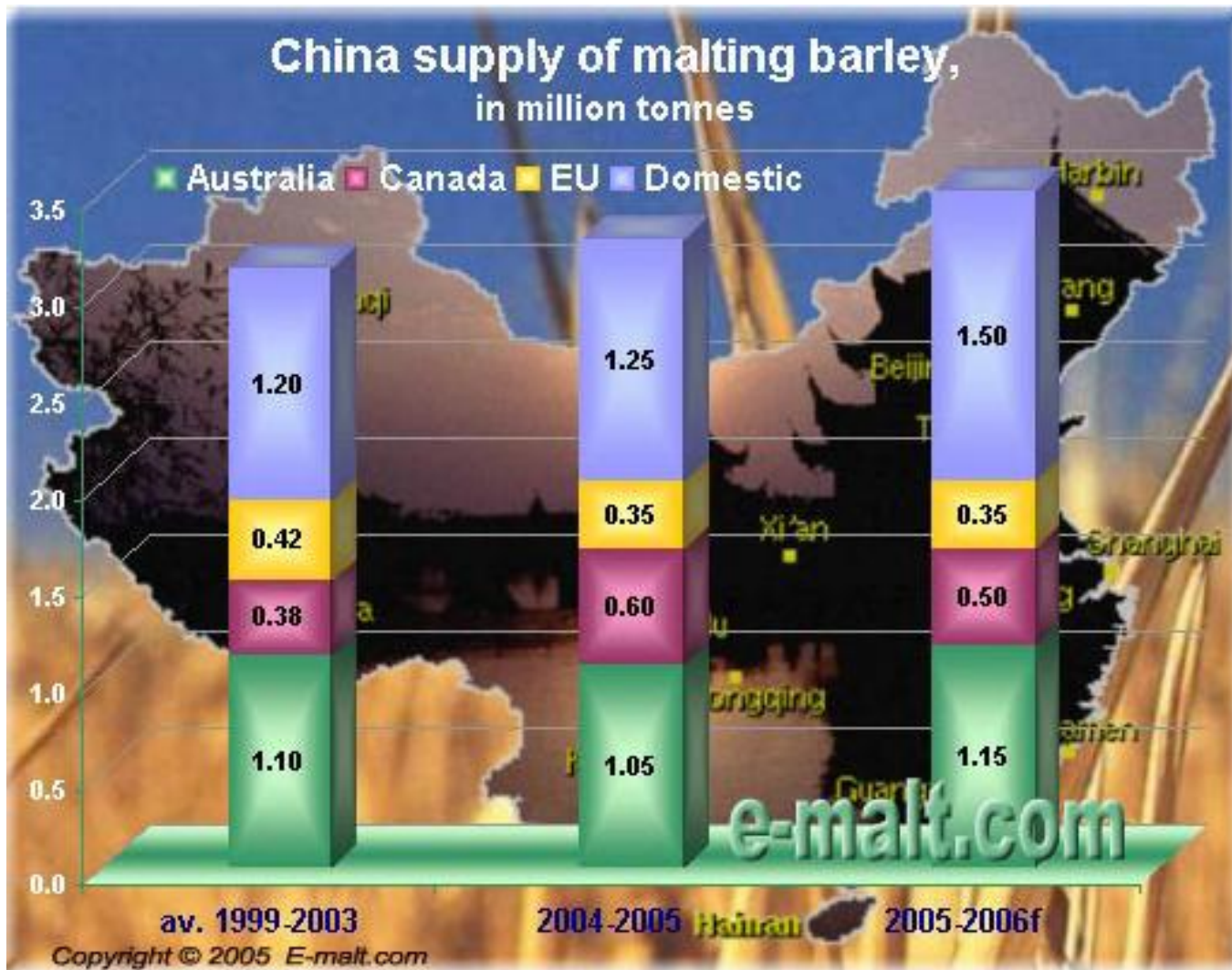


China: Beer vs. Malting Barley Demand

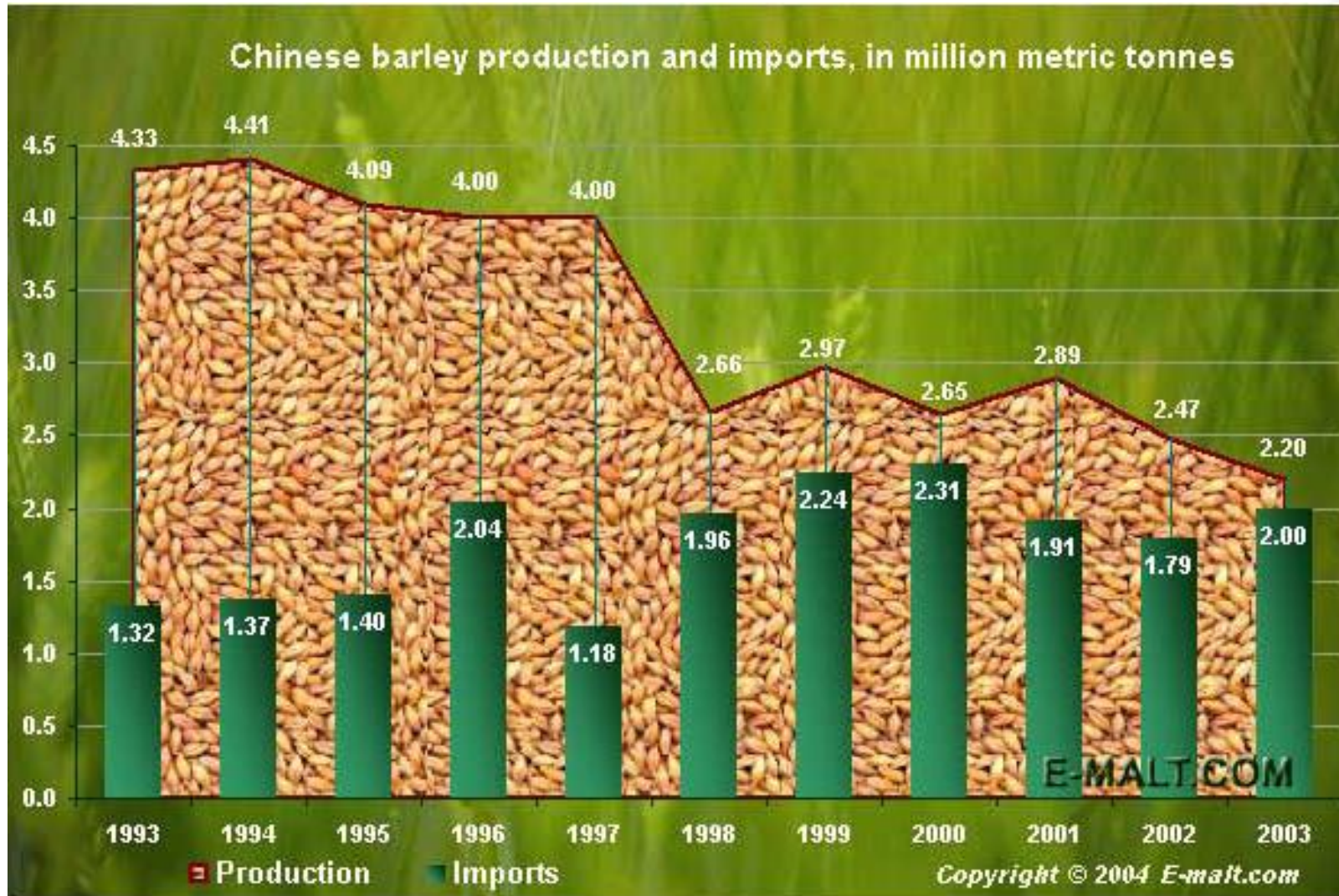


Adapted from: China National Bureau of Statistics, Agriculture and Agri-food Canada.
f: Agriculture and Agri-food Canada forecast.

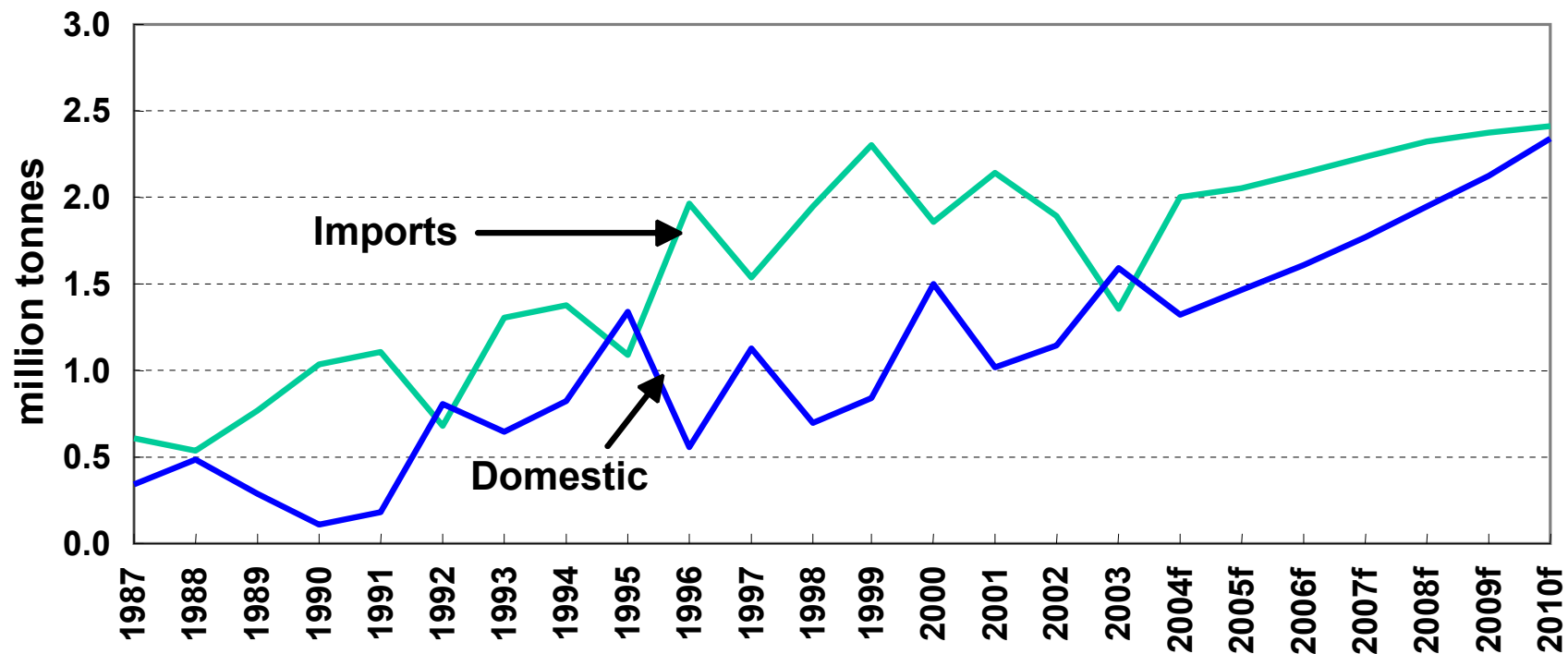
China Barley Supply



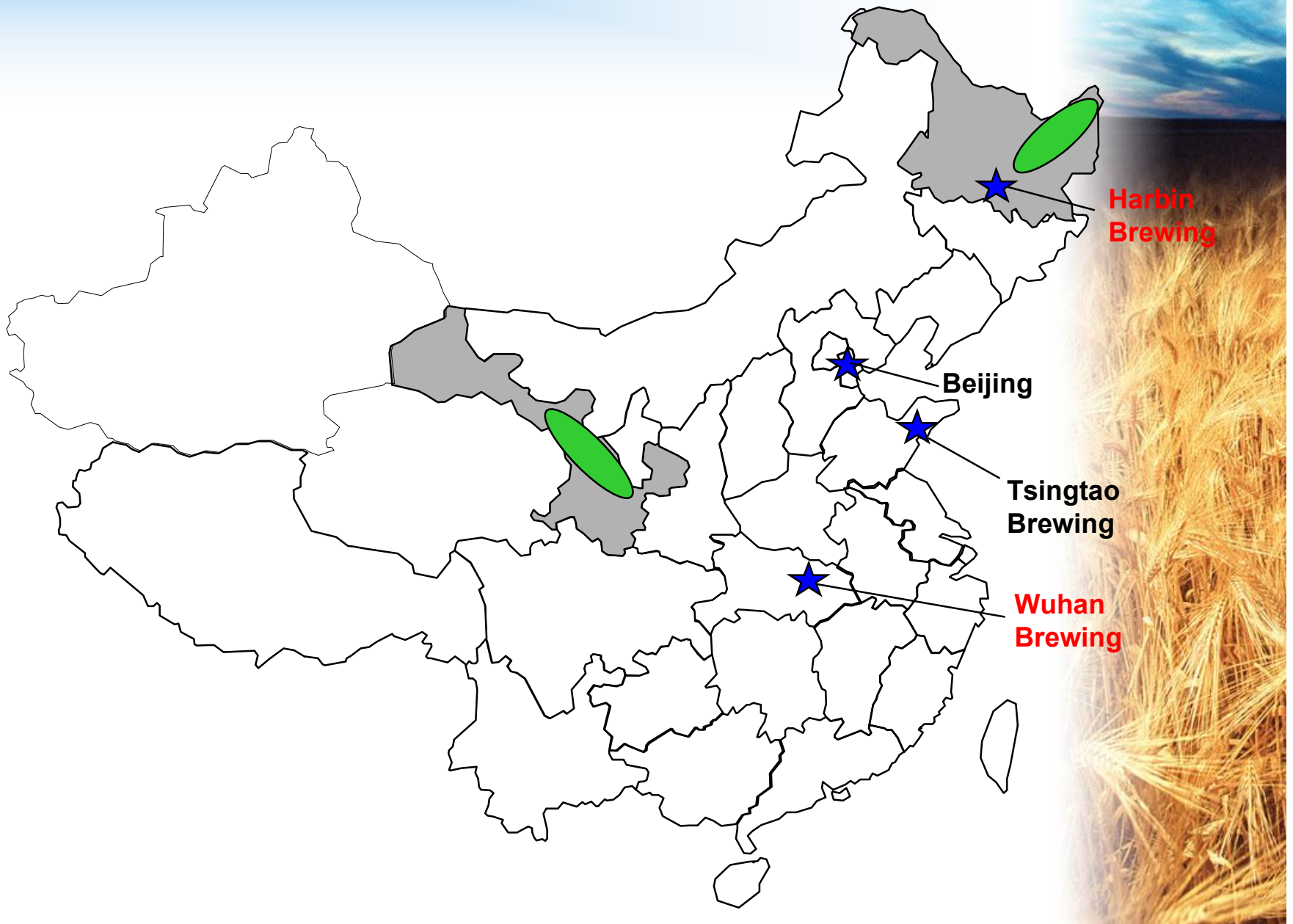
Chinese Barley



China Barley: Domestic vs. Import



Barley Regions



China Malt Barley Production Issues

- The major issues limiting China's ability to grow its domestic malt barley supply are:
 - Low and inconsistent grain quality...variety and growing practices
 - Post harvest quality deterioration...handling and storage
 - High logistical costs and infrastructure constraints...growing region specific
 - An underdeveloped quality control system



Thank You

